WE CLAIM:

1. A method of detecting a chemical species using a spectroscopy system, the method comprising the steps of:

providing at least one light source emitting a beam of light incident to the chemical species, the beam of light causing the chemical species to emit a signal and a photochemical reaction to shift a spectrum of the signal emitted by the chemical species; and

providing a detector positioned to detect the signal from the chemical species.

2. A method of claim 1, further including a step of providing a data processor system in communication with at least one of the detector and the at least one light source.

3. A method of claim 1, wherein the step of providing the at least one light source emitting the beam of light includes providing the beam of light with a first wavelength and a second wavelength wherein the first wavelength is greater than or equal to the second wavelength.

4. A method of claim 3, wherein the step of providing the first and second wavelengths includes providing the first wavelength in a range from infrared to ultraviolet and providing the second wavelength in an ultraviolet range.

5. A method of claim 4, wherein the first wavelength causes the chemical species to emit the signal and the second wavelength causes the

photochemical reaction to shift the spectrum of the light emitted by the chemical species.

6. A method of claim 1, wherein the step of causing the photochemical reaction includes forming colored chemical products which emit the signal.

7. A method of claim 2, wherein the step of identifying the chemical species includes detecting an azo compound.

8. A method of claim 1, wherein the step of providing the at least one light source includes providing at least one of a white light source, a liquid crystal display projector, a xenon flash lamp, a fluorescent light source, a high intensity discharge lamp, a light emitting diode, a gas laser, a semiconductor laser, an unmodulated light source, a mercury arc lamp, a mercury arc lamp with a fused quartz filter, an ultraviolet light source, a germicidal ultraviolet light source, and an electromagnet.

9. A method of claim 1, further including a step of increasing a power output of the at least one light source as a stand-off distance between the chemical species and the spectroscopy system increases.

10. A method of detecting a chemical species at a stand-off distance using a spectroscopy system, the method comprising the steps of:

providing a first beam of light at a first wavelength incident to the chemical species, the first beam of light causing the chemical species to emit a signal;

providing a second beam of light at a second wavelength, the second beam of light causing a photochemical reaction in the chemical species to shift a spectrum of the signal emitted by the chemical species;

providing a detector positioned to detect the signal emitted from the chemical species; and

providing a data processor system in communication with the detector to process the signal to determine the identity of the chemical species.

11. A method of claim 10, wherein the step of causing the chemical species to emit the signal includes emitting at least one of an acoustic signal and an optical signal.

12. A method of claim 10, wherein the step of detecting the signal emitted from the chemical species includes using at least one of an acoustic detector and a photodetector.

13. A method of claim 10, wherein the step of detecting the signal emitted from the chemical species includes detecting the chemical species wherein the stand-off distance is in a range from approximately 1 meter to 500 meters.

14. A method of claim 10, wherein the step of identifying the chemical species includes detecting at least one of trinitrotoluene (TNT), dinitrotoluene (DNT), a nitroaromatic, a pesticide, a chemical compound with a benzene ring, and a chemical which generates a signal caused by the first beam of light.

15. A method of claim 10, further including a step of modulating the light source at a frequency in a range from approximately 10 Hertz to 30000 Hertz.

16. A method of claim 10, wherein the step of providing the first and second beams of light includes the step of making the first wavelength greater than or equal to the second wavelength.

17. A method of detecting a chemical species at a stand-off distance using a spectroscopy system, the method comprising the steps of:

providing a modulated light source emitting a first beam of light at a first wavelength incident to the chemical species, the first beam of light causing the chemical species to emit a signal;

providing a spectral shifter emitting a second beam of light at a second wavelength, the second beam of light causing a photochemical reaction in the chemical species to shift a spectrum of the chemical species;

providing a detector positioned to detect the signal from the chemical species; and

providing a data processor system in communication with at least one of the detector and the modulated light source, the data processor system processing the signal to determine the identity of the chemical species.

18. A method of claim 17, further including a step of increasing a power output of at least one of the modulated light source and the spectral shifter as the stand-off distance increases.

19. A method of claim 17, further including a step of providing a lock-in amplifier in communication between the modulated light source and the data processor system.

20. A method of claim 17, wherein the step of providing the detector includes a step of providing at least one of an acoustic detector, a microphone, an optical microphone, a capacitive microphone, a hydrophone, an optical grating microphone, a photodetector, an imaging device, and a detector capable of detecting the signal emitted from the chemical species.

21. A method of claim 17, wherein the step of identifying the chemical species includes detecting an azo compound with at least one of H-, OH-, CN-, a carbonyl compound, and another molecule which forms colored chemical products which emit the signal.

22. The method of claim 17, further including a step of modulating the modulated light source at a frequency in a range from approximately 10 Hertz to 1000 Hertz.

23. A spectroscopy system for detecting a chemical species, the system comprising:

at least one light source capable of emitting a beam of light incident to the chemical species, the beam of light causing the chemical species to emit a signal and further causing a photochemical reaction to shift a spectrum of the light emitted from the chemical species; and

a detector positioned to detect the signal emitted from the chemical species.

24. A system of claim 23, wherein a data processor system is in communication with at least one of the detector and the at least one light source, the data processor system processing the signal.

25. A system of claim 23, wherein the at least one light source is capable of emitting the beam of light with a first wavelength and a second wavelength wherein the first wavelength is greater than or equal to the second wavelength.

26. A system of claim 25, wherein the first wavelength is in a range from infrared to ultraviolet and the second wavelength is in an ultraviolet range.

27. A system of claim 26, wherein the first wavelength causes the chemical species to emit the signal and the second wavelength causes the photochemical reaction to shift the spectrum of the chemical species.

28. A system of claim 23, wherein the photochemical reaction forms colored chemical products which emit the signal.

29. A system of claim 23, wherein the chemical species includes an azo compound.

30. A system of claim 23, wherein the at least one light source is modulated at a frequency to increase a signal-to-noise ratio of the signal.

31. A system of claim 23, wherein a power output of the at least one light source is increased as a stand-off distance between the chemical species and the spectroscopy system increases.

32. A spectroscopy system for detecting a chemical species at a stand-off distance, the system comprising:

a first light source capable of emitting a first beam of light at a first wavelength incident to the chemical species, the first beam of light causing the chemical species to emit a signal;

a second light source capable of emitting a second beam of light at a second wavelength, the second beam of light causing a photochemical reaction in the chemical species to shift a spectrum of the light emitted from the chemical species;

a detector positioned to detect the signal emitted from the chemical species; and

a data processor system in communication with the detector to process the signal to determine the identity of the chemical species.

33. A system of claim 32, wherein the signal emitted from the chemical species includes at least one of an acoustic signal and an optical signal.

34. A system of claim 32, wherein the detector includes at least one of an acoustic detector, a microphone, an optical microphone, a capacitive microphone, a hydrophone, an optical grating microphone, a photodetector, an imaging device, and a detector capable of detecting the signal emitted from the chemical species.

35. A system of claim 32, wherein the chemical species includes at least one of trinitrotoluene (TNT), dinitrotoluene (DNT), a nitroaromatic, a pesticide, a chemical compound with a benzene ring, and a chemical which generates a signal caused by the first beam of light.

36. A system of claim 32, wherein the first light source is modulated at a frequency in a range from approximately 10 Hertz to 30000 Hertz.

37. A system of claim 32, wherein the first light source includes at least one of a white light source, a liquid crystal display projector, a xenon flash lamp, a fluorescent light source, a high intensity discharge lamp, a light emitting diode, a gas laser, and a semiconductor laser.

38. A system of claim 32, wherein the second light source includes at least one of an unmodulated light source, a mercury arc lamp, a mercury arc lamp with a fused quartz filter, an ultraviolet light source, a germicidal ultraviolet light source, an electromagnet, and a light source which shifts a spectrum of the chemical species into a spectral region of the first light source.